



LEFT BUNDLE-BRANCH BLOCK WITH UNFAVOURABLE OUTCOMES

REPORT OF TWO CASES &

Review Of The Clinical Management and Aeromedical Decision Making

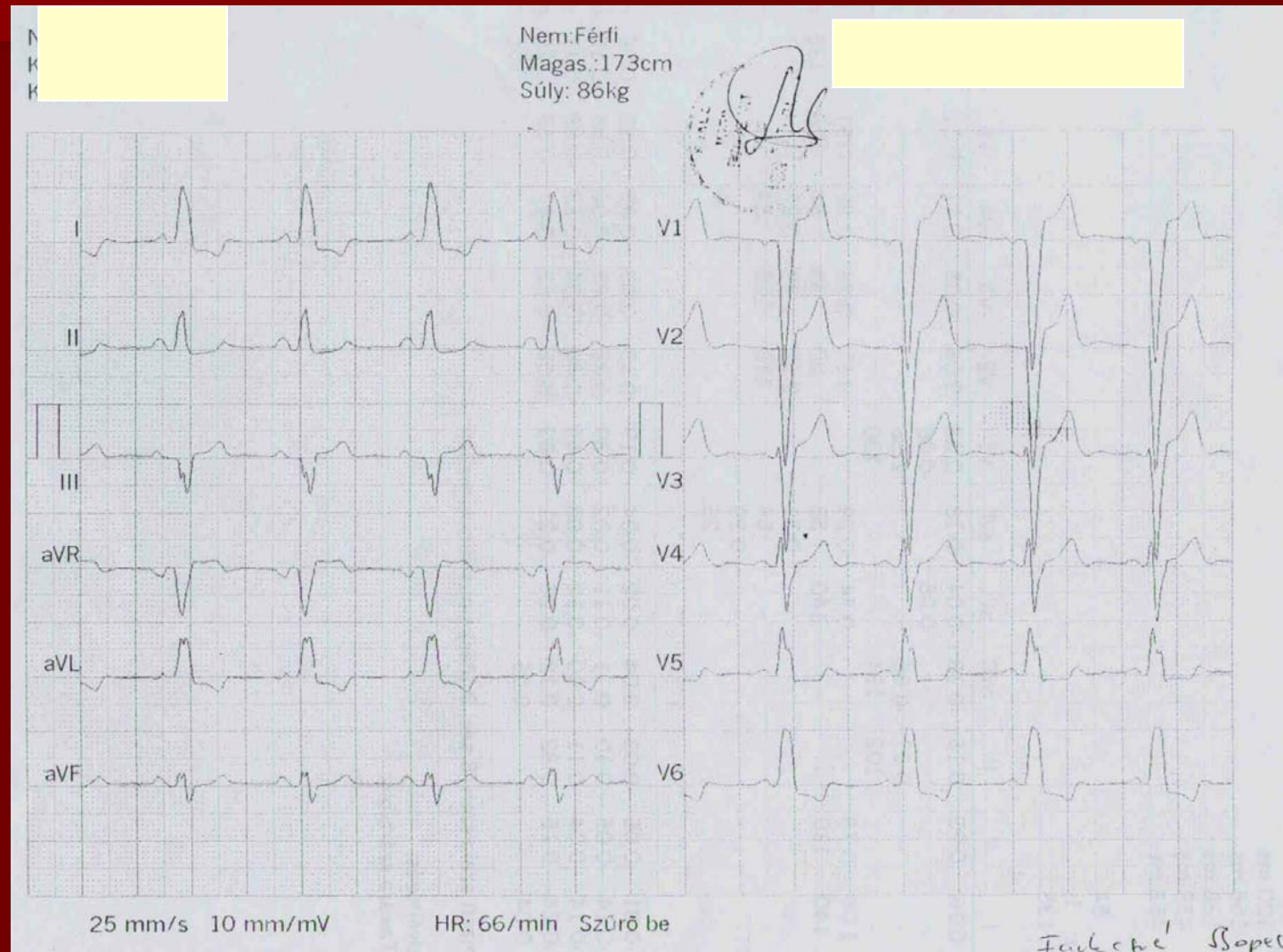
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Case No 1. Acquired LBBB

Class 1 Medical Certificate (male, 40y, 737 cpt)



Case No 1.

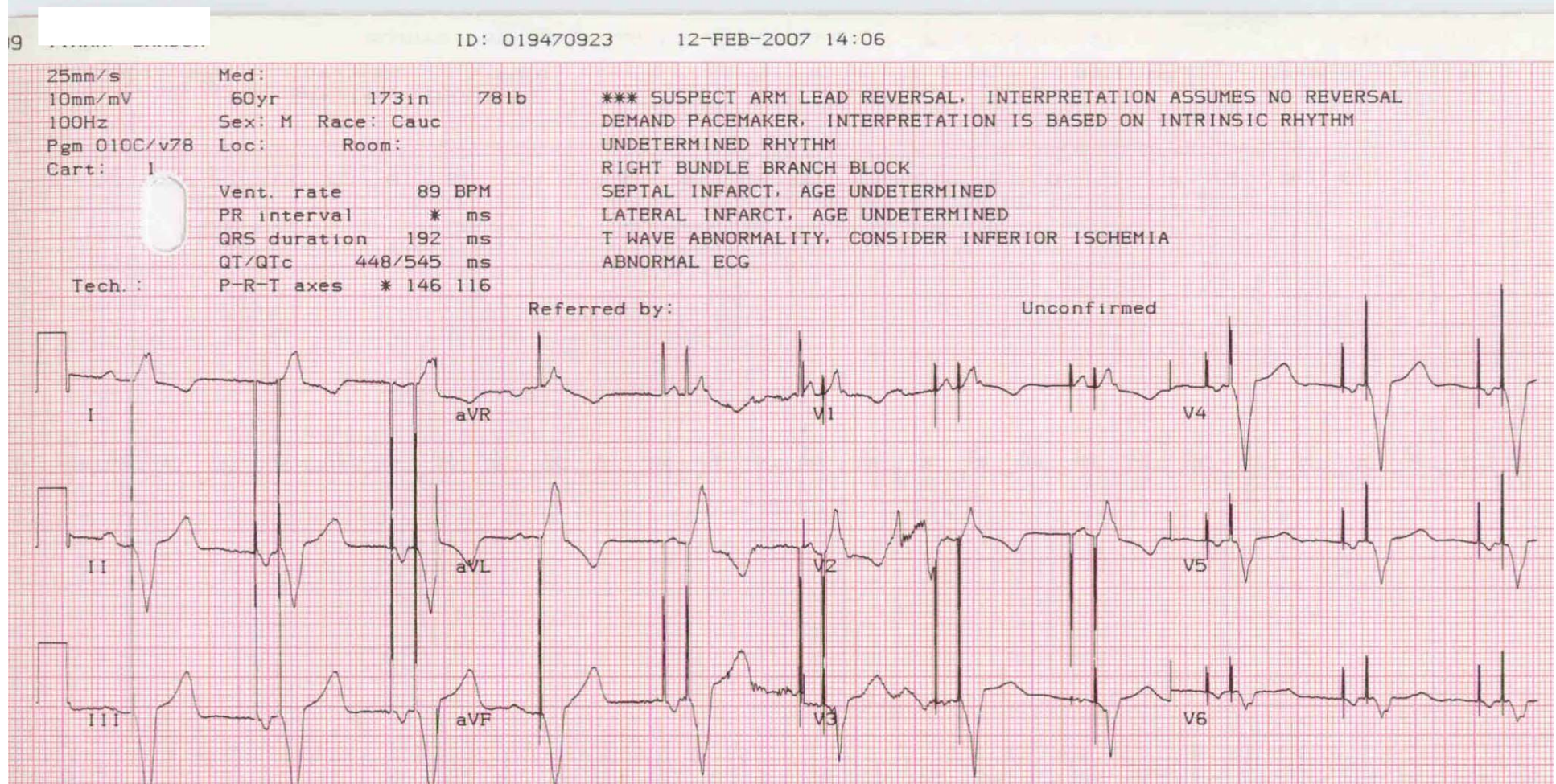
- Male ATPL pilot (59 years) with Left Bundle-Branch Block (LBBB). LBBB was acquired 19 years before.
- Complete evaluations were carried out according to the national regulations and since 2002 properly to the JAR-FCL 3.
- Normal coronary angiography, no sign for impaired Left Ventricle (LV) function's
- No risk factors for coronary artery disease.

Case No 1. cont'l

- Every 6 month regular aeromedical exam, regular cardiological control: No significant medical history
- Acute viral infection complicated with viral myocarditis caused 3rd degree AV block.
- Thanks to the 35/min ventricular escape rhythm in that acut need he was able to call for help.
- 90 minutes after the first symptoms he received provisionally pacemaker therapy.
- Later on he recovered from the viral myocarditis, however was grounded due to pacemaker dependency.

Case No 1. cont'l

grounded due to pacemaker dependency



Case No 1. cont'l

grounded due to pacemaker dependency



Case No 2. Acquired LBBB

Class 2 Medical Certificate (male, 34y, ppl)



Case No 2. Acquired LBBB

Class 2 Medical Certificate (male, 34y, ppl)

- New LBBB and hypertension were confirmed by the regular aeromedical examination at the 34 years old male PPL licence holder.
- Echo: mild dilatation of both atria & LV, EF: 63%, impaired relaxation.
- Normal stress ECG, except of LBBB
- Myocardium scintigraphy: medium degree left ventricular hypertrophy and inverse septal perfusion disturbances, interpreted as consequences of LBBB.
- Blood pressure well controlled by acceptable medications.
- Obesity BMI: 33.89, non-smoker

Case No 2.

- According to JAR-FCL 3 Class 2. Medical Certificate was issued.
- Next medical check-up: no changes
- 4 years later his son suffered from varicella for 4-5 days. The pilot mentioned uncharacteristic complaints like headache, dead-beatness and weakness for 2 days.
- The following morning he was find dead in his bed

Case No 2. **Autopsy findings**

- Enlarged heart – cor bovinum – weight 650 gr,
- Slightly increased subepicardial fat.
- The atria and the ventricles were dilatated with excentric hypertrophy.
- LV wall 19 mm, Right ventricle wall 8mm.
- The coronary system was practically free of signs of atherosclerosis.

Case No 2. Autopsy findings

Hystopathology

- „Segmentatio et fragmentatio myocardii. Hypertrophia myocardii” without specific signs.
- The liver was enlarged- 3800 gr – with histological signs of steatosis, due to obesity.
- Left ventricle failure was assigned as cause of death, on the base of heart enlargement due to obesity.

Left Bundle-Branch Block

Pathophysiology, Prognosis, and Clinical Management

Asymptomatic Left Bundle-Branch Block: Prognosis

Are we dealing with the preclinical stage of a
structural heart disease

or

rather with a borderline physiologic phenomenon not
necessarily implying future clinical consequences?

Asymptomatic Left Bundle-Branch Block: Prevalence, Prognosis, and Concerns

This is exactly the case of LBBB in apparently healthy subjects, a paradigmatic example of "medical rebus."

In the setting of LBBB and apparent structural heart diseases, the available observational studies suggest caution and often concern in the prognostic evaluation.

On the other hand, new onset LBBB in asymptomatic subjects raises several questions concerning the diagnostic algorithm and the clinical behaviour, with particular regard to the need for further investigation, intensity and nature of follow-up

Asymptomatic Left Bundle-Branch Block: Prevalence

In epidemiologic studies conducted during the last 30 years, the prevalence of LBBB in the general population has been reported to vary considerably according to population size and sampling criteria, ranging from 0.1–0.8%.

Asymptomatic Left Bundle-Branch Block: Prognosis

There is no consensus on LBBB-related prognosis, as the latter is clearly influenced by study design, population size, and heterogeneity.

Asymptomatic Left Bundle-Branch Block: Prognosis

TABLE 2 Outcomes in subjects and patients with left bundle-branch block (LBBB)

First author (RefNo.)	Year	n	Mean age (years)	Sample	Outcome
Eriksson (28)	1998	855	70	Men born 1913	Increased mortality for LBBB only in conjunction with CAD
Fahy (18)	1995	100,000	44	Screening	Increased prevalence of cardiovascular disease at follow-up Increased cardiac mortality for LBBB+CAD No differences in all-cause mortality for LBBB
Schneider (17)	1981	5,209	50	Framingham	Increased mortality for LBBB
Rotman (15)	1975	237,000	35	U.S. Air Force	No increased mortality for LBBB
Hesse (58)	2001	7,073	60	Stress testing	Increased all-cause mortality for LBBB
Freedman (20)	1987	15,609	55	Chronic CAD	Increased mortality for LBBB
Wong (24)	2006	17,073	68	Acute MI	Increased 30-day mortality for LBBB
Guerrero (23)	2005	3,053	69	Acute MI	Increased in-hospital death for LBBB
Stenestrand (27)	2004	88,026	77	Acute MI	Increased unadjusted 1-year mortality
Brilakis (26)	2001	894	76	Acute MI	Lower pre-discharge ejection fraction Higher in-hospital and long-term unadjusted mortality
Baldasseroni (10)	2002	5,517	63	CHF	Increased 1-year mortality and sudden death

Abbreviations: CAD = coronary artery disease, MI = myocardial infarction, CHF = congestive heart failure.

P. FRANCIA, M.D., et al.: Left Bundle-Branch Block—Pathophysiology, Prognosis, and Clinical Management. Clin. Cardiol. 30, 110–115 (2007)



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[List of Contributors](#)

D. J. ROWLANDS:

Left and right bundle branch block,

left anterior and left posterior hemiblock

OVERALL CONCLUSIONS CONCERNING LBBB

- (a) Isolated LBBB is uncommon in the absence of clinically evident heart disease.
- (b) Isolated LBBB is rarely associated with A–V block or syncope.
- (c) Pre-existing LBBB in the absence of clinical evidence of disease carries a slightly higher mortality rate than normal, the mortality risk ratio being of the order of 1.3. 
- (d) Newly acquired LBBB carries a substantially higher mortality rate – the mortality risk ratio being 10. 
- (e) No adequate information is available on the prognosis of incomplete LBBB.

Left Bundle-Branch Block and Risk: Stratification in Heart Disease

- Left bundle-branch block early affects prognosis of ischemic heart disease; several different mechanisms account for such an effect.
- When LBBB expresses an unrecognized underlying nonischemic structural heart disease, LV performance may be depressed and inadequate to face up to an acute ischemic event.
- Moreover, LBBB itself induces intra- and interventricular asynchrony, abnormal LV diastolic filling patterns, and impairment of LV systolic performance.

Littmann L, Symanski JD. Hemodynamic implications of left bundlebranch block.
J Electrocardiol 2000;33(suppl):115–121.

Left Bundle-Branch Block and Risk Stratification in Heart Disease

In LBBB the prolongation of the depolarization phase and the subsequent increase in vulnerable repolarization time heightens the risk of life-threatening ventricular arrhythmias in the presence of frequent ventricular ectopic beats, a common finding in the setting of ischemic heart disease

Englund A, Bergfeldt L, Rehnqvist N, Astrom H, Rosenqvist M: Diagnostic value of programmed ventricular stimulation in patients with bifascicular block: A prospective study of patients with and without syncope. *J Am Coll Cardiol* 1995;26:1508–1515.

Left Bundle-Branch Block and Risk Stratification in Heart Disease

On the basis of the evidence presented by Fuster, it is **imperative in clinical practice to consider the possibility** that LBBB represents the clinical onset of an idiopathic dilated cardiomyopathy or an infective, hypertensive, or valvular “dilated heart disease.”

This is particularly true in “tricky” forms of clinically silent structural heart disease, often characterized by borderline values of LV volume and ejection fraction.

Dec GW, Fuster V: Medical progress: Idiopathic dilated cardiomyopathy.
N Engl J Med 1994;331:1564–1575.

The Issue of Advanced Atrioventricular Block

Recent data from the International Study on Syncope of Uncertain Etiology (ISSUE)⁴² show that in patients with BBB (patients with LBBB representing 38% of the study population), syncope, and negative electrophysiologic study, most syncopal recurrences are due to prolonged asystolic pauses mainly attributable to paroxysmal AV block, as assessed by implantable loop recorder traces.

Menozi C, Brignole M, Garcia-Civera R, Moya A, Botto G, et al.;
International Study on Syncope of Uncertain Etiology (ISSUE) Investigators: Mechanism of syncope in
patients with bundle branch block and negative electrophysiological test.
Circulation 2002;105:2741–2745.

The Issue of Advanced Atrioventricular Block

This finding claims a very low negative predictive value of an invasive electrophysiologic study in ruling out a paroxysmal AV block as the cause of syncope, since 33% of the patients with a negative study had a documented episode of AV block.

Notably, the study failed to identify any risk predictor of future AV block.

Menozi C, Brignole M, Garcia-Civera R, Moya A, Botto G, et al.;
International Study on Syncope of Uncertain Etiology (ISSUE) Investigators: Mechanism of syncope in
patients with bundle branch block and negative electrophysiological test.
Circulation 2002;105:2741–2745.

The Issue of Advanced Atrioventricular Block

The authors conclude that in patients with symptomatic BBB and negative electrophysiologic study, an implantable loop recorder-guided strategy is reasonable, with pacemaker implantation safely delayed until symptomatic bradycardia is documented.

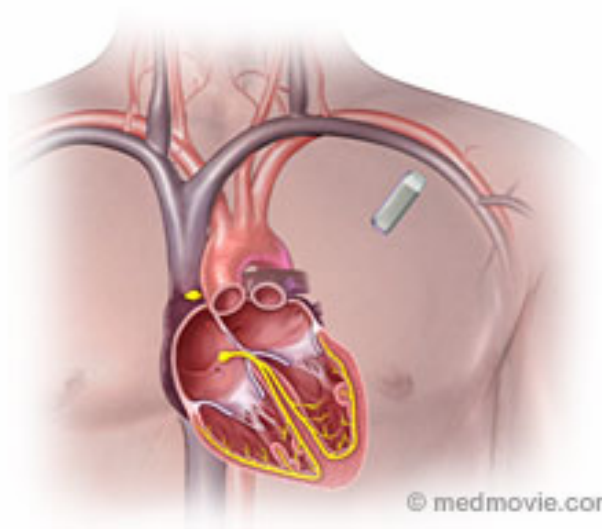
Menozzi C, Brignole M, Garcia-Civera R, Moya A, Botto G, et al.;
International Study on Syncope of Uncertain Etiology (ISSUE) Investigators: Mechanism of syncope in
patients with bundle branch block and negative electrophysiological test.
Circulation 2002;105:2741–2745.

Implantable Loop Recorder

An implantable loop recorder is a small device that is implanted under the skin to help identify the causes of fainting. Syncope (or fainting) is a temporary loss of consciousness. Certain heart disorders can cause fainting, such as abnormal heartbeats called arrhythmias.

An implantable loop recorder is a small device that is inserted under the skin below the collar bone (usually on the patient's left side). The procedure to implant the device is simple. Local anesthetic is injected into the area. A small incision is made and the device is inserted. The skin is then sutured closed. The device continuously records heart activity similar to an ECG for up to 2 years. If the patient experiences an episode of fainting, the device is activated to save the recording before, during, and after the episode. The recordings can then be evaluated by a physician to help determine the cause of fainting.

Click the image to view an animation on implantable loop recorders



The Long and Winding Road of Clinical Management

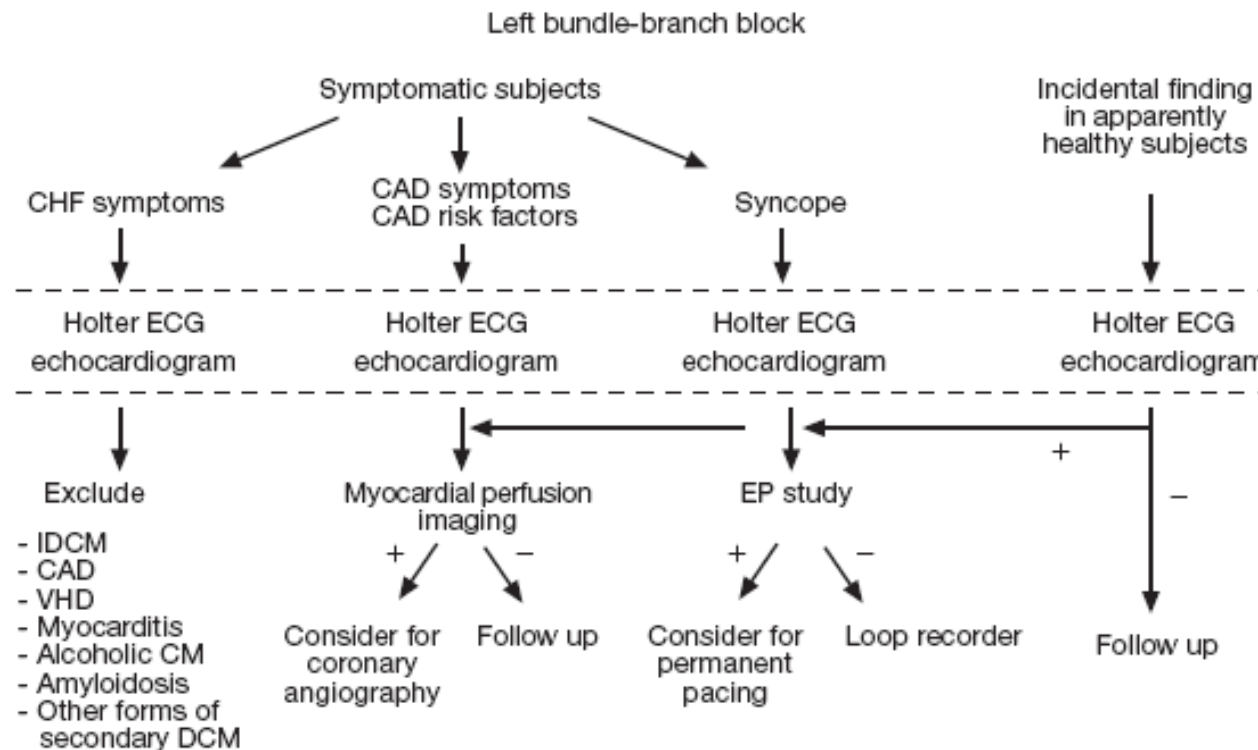


FIG. 1 Flow-chart of proposed clinical approach to an individual or patient presenting with left bundle-branch block. CHF = congestive heart failure, CAD = coronary artery disease, EP = electrophysiologic, IDCM = idiopathic dilated cardiomyopathy, VHD = valvular heart disease, CM = cardiomyopathy, DCM = dilated cardiomyopathy.

P. FRANCIA, M.D., et al.: Left Bundle-Branch Block—Pathophysiology, Prognosis, and Clinical Management. Clin. Cardiol. 30, 110–115 (2007)

Future Perspectives:

Should We Treat Patients or Electrocardiographic Traces?

Recent successes of cardiac resynchronization therapy (CRT) in chronic heart failure highlight the hemodynamic effects of LBBB, so far considered roughly an electrocardiographic entity.

Noncoordinated contraction of interventricular septum and LV posterior or posterolateral wall results in waste of energy contraction, inability to generate effective intraventricular pressure, and increased wall tension at the level of latest activated regions of the LV.

Future Perspectives: Should We Treat Patients or Electrocardiographic Traces?

While referral for resynchronization therapy currently applies to subjects with severe heart disease, indications for physiologic pacing are expanding.

The new millennium is marking the transition of LBBB from risk stratification factor to rational therapeutic target.

P. FRANCIA, M.D., et al.: Left Bundle-Branch Block—Pathophysiology, Prognosis, and Clinical Management. Clin. Cardiol. 30, 110–115 (2007)

JAR-FCL 3.145

JAR-FCL 3.265

(f) Applicants with complete left bundle branch block shall be assessed as unfit.

A fit assessment may be considered by the AMS in compliance with paragraph 7 Appendix 1 to Subpart B & C

paragraph 7 Appendix 1 to Subpart B & C

7 Any significant rhythm or conduction disturbance requires evaluation by a cardiologist acceptable to the AMS and appropriate follow-up in the case of a fit assessment.

(a) Such evaluation shall include:

(1) Exercise ECG to the Bruce protocol or equivalent. The test should be to maximum effort or symptom limited. Bruce stage 4 shall be achieved and no significant abnormality of rhythm or conduction, nor evidence of myocardial ischaemia shall be demonstrated. Withdrawal of cardioactive medication prior to the test should be considered.

(2) 24-hour ambulatory ECG which shall demonstrate no significant rhythm or conduction disturbance,

(3) 2D Doppler echocardiogram which shall show no significant selective chamber enlargement, or significant structural, or functional abnormality, and a left ventricular ejection fraction of at least 50%.

(b) Further evaluation may include:

(1) [] [Repeated] 24-hour ECG recording;

(2) Electrophysiological study;

(3) Myocardial perfusion scanning, or equivalent test;

(4) Cardiac MRI or equivalent test;

(5) Coronary angiogram or equivalent test (see Appendix 1 paragraph 6).

Pharmacological stress, often using adenosine, is more useful than exercise stress and is mandatory in the investigation of left bundle branch block. Other radionuclides such as MIBI are also permissible. When radionuclide techniques are used to assess left ventricular ejection fraction it, should be >50%

paragraph 7 Appendix 1 to Subpart B & C

(3) Complete left bundle branch block

Investigation of the coronary arteries is necessary in applicants over age 40.

(i) Initial Class 1 applicants should demonstrate a 3 year period of stability.

(ii) [] [For] Class 1 revalidation/renewal[, after a 3 year period with a multi-pilot (Class 1 'OML') limitation applied, a fit assessment without multi-pilot (Class 1 'OML') limitation] may be considered[].

- A left bundle branch block (LBBB) is more of a concern because of the **stronger correlation to coronary artery disease**. LBBB makes interpretation of an electrocardiogram difficult because the bundle block masks part of the ECG tracing that identifies possible vessel blockage. For that reason, if there is a history of left bundle branch block, or a right bundle branch block in an individual over the age of 30, the FAA will request an *exercise radionuclide scan* as part of the cardiovascular evaluation.

Additional Pilot Medical Requirements Addressed by FAA

Pilot Section

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FAA Aerospace Medical Disease Protocols Graded Exercise Stress Test (Treadmill) Additional Bundle Block Branch Requirements



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Overall Problem List
CFR Part 67 Index
Class 1 Standards
Class 2 Standards
Class 3 Standards
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Heart Section



If the Bundle Block Branch (BBB) has been previously documented and evaluated, no further evaluation is required. A medical certificate should not be issued to any class if the applicant has a new onset of a bundle branch block. A **right** BBB in an otherwise healthy person 30 years of age or younger should not require a **CVE**. All other individuals who do have a right BBB require a **CVE** but a radionuclide study should not be required unless the standard exercise stress test cannot be interpreted. A stress echocardiogram may be sufficient in most cases. A **left** BBB in a person of any age should have a **CVE** and should include a radionuclide perfusion study. **Those individuals who have a negative work-up may be issued the appropriate class of medical certificate. No followup is required.** If any future changes occur, a new current **CVE** will be required.

If areas of ischemia are noted, a coronary angiogram may be indicated for definitive diagnosis. According to the current literature, approximately 40% of individuals with LBBB will demonstrate a false positive thallium reperfusion defect in the septal area. If significant **CAD** (CHD) is diagnosed, refer to Special Issuance guidelines. Some cases may be forwarded to a FAA-selected cardiology consultant specialist for review and recommendation for medical certification.

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Decision Considerations

Disease Protocols - Graded Exercise Stress Test - Bundle Block Branch Requirements

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Bundle Branch Block


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Left bundle branch block and right bundle branch block of recent onset, indicate the need for a cardiovascular examination to rule out heart disease, especially ischemic heart disease. Isolated right bundle branch block and left hemiblocks that are longstanding are generally benign.

International Standards
and Recommended Practices



Annex 1
to the Convention on
International Civil Aviation

Personnel Licensing



Doc 8984-AN/895
Part III

MANUAL OF CIVIL AVIATION MEDICINE
PRELIMINARY EDITION — 2008
International Civil Aviation Organization

Left bundle branch block

Incomplete left bundle branch block is an ECG diagnosis which applies when the standard criteria for left bundle branch block are satisfied (absent q wave in SI, aVL, V5 and V6; absent r' in V1, with or without secondary T wave changes) but the QRS complex width is <120 ms. See Appendix 1b: 2. The distinction is arbitrary. If long-standing and the heart is structurally and functionally normal, there appears to be little or no increased risk, and such individuals need not be restricted.

In the event of new presentation, the structural integrity of the heart needs to be established with echocardiography. The possibility of coronary artery disease needs to be considered and excluded with pharmacological stress thallium MPI or coronary angiography as an exercise ECG is likely to be abnormal due to secondary repolarisation change.

Complete left bundle branch block has had a malign reputation, partly on account of its association with coronary artery disease in older subjects in whom the incidence may be as high as 25 to 50 per cent. It is one-tenth as common as right bundle branch block in the general population. Newly acquired left bundle branch block in one study observed a risk ratio for sudden cardiac death of 10:1 (i.e. 10 times greater than expected) > age 45 years, although below that age the risk ratio was 1.3:1. Notwithstanding, stable complete left bundle branch block appears to carry little excess risk of cardiovascular event in the otherwise normal heart and may be consistent with multi-crew operation. See Appendix 1b: 17 for an example and morphological description. Coronary angiography or pharmacological stress myocardial perfusion imaging (MPI) is needed to exclude the possibility of coronary artery disease.

Applicants with the first presentation of left bundle branch block may be considered for a restricted Class 1 (OML) Medical Assessment provided that:

- • *Left ventricular function is normal*, eg the ejection fraction is > 50 per cent as measured by echocardiography (Simpson's rule), multiple-gated acquisition (MUGA) study, or contrast ventriculography
 - • *Exercise ECG to stage IV of the Bruce treadmill protocol can be achieved without evidence of myocardial ischaemia, significant rhythm disturbance or symptoms*
 - • *Pharmacological stress thallium MPI, or equivalent, shows no evidence of a reversible defect. A small fixed defect is permissible, provided the ejection fraction is within the normal range*
 - • *Coronary angiography, if carried out, demonstrates <50 per cent stenosis in any major untreated vessel or in any venous/arterial graft remote from any infarction; <30 per cent if the proximal the left anterior descending or left main-stem vessels are involved*
 - • *Holter monitoring, if indicated, shows no significant rhythm disturbance*
- *Annual follow up is carried out by a cardiologist acceptable to the Licensing Authority*

Are the unusual events in this cases sufficient to question the original decision making process?



LBBB

It has no predictive value!

(3) Complete left bundle branch block

Investigation of the coronary arteries is necessary in applicants over age 40.

(i) Initial Class 1 applicants should demonstrate a 3 year period of stability.

(ii) [][For] Class 1 revalidation/renewal[, after a 3 year period with a multi-pilot (Class 1 'OML') limitation applied, a fit assessment without multi-pilot (Class 1 'OML') limitation] may be considered[].

No clinical basis of the consideration!

• Annual follow up required by a cardiologist



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Thank You for



Your Attention!



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